VIGYAN SIKSHAK

The Science Teacher

Volume : 49 ★ No. 2 ★ April-June-2005

39th Annual Conference : Special Issue

All India Science Teachers' Association

Inaugural Session : A view of the dias from Left to right - Smt. M. Prakash, Shri Vijay Prakash, Shri Basudeo Singh, Prof. Rajmani Pd. Sinha, Dr. S. N. Giri, Prof. R. P. Singh, Prof. J. N. Chatterjea, Dr. Vijay Krishna.

Dr. S. N. Giri, Prof. J. N. Chatterjea, Dr. Vi Krishna, Dr. M. M. Chel, Prof. Vinay Kr. Kan Prof. Saroj Bala Sinha

Girls of BNR Training College & Sangeet Mandir, Patna performing welcome dance.

Girls of BNR Training College & Sangeet Mandir, Patna Performing welcome dance.

Eminent chemist Prof. J. N. Chatterjea inaugurating the AISTA conference, on his left Prof. Jayshree Bhattacharya & Right Prof. S. B. Sinha

Welcome address by Prof. (Smt.) Saroj Bala Sinha

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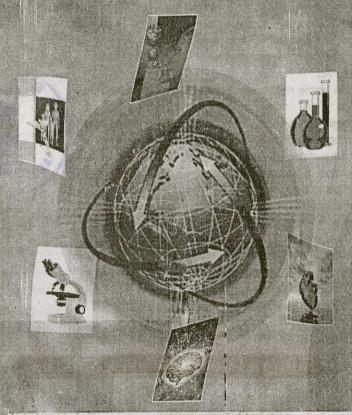
The Science Teacher

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Volume 49 • No. - • April, May & June 2005

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Editorial Board : Vigyan Shikshak

Apology for the error

'Vigyan Shikshak' is a quarterly Journal so the no. of the issue of Jan-March 2005 should be 1 (one) In the list of Office-bearers of AISTA on page-21. One of the Patron. Prof. J.S. Rajput is now Ex-director of NCERT.

Editorial

A STEP TOWARDS THE GOLDEN JUBILEE OF AISTA

This issue of the 'Vigyan Shikshak' is confined to the academic session of the 39 th Annual Conference of the AISTA. The previous issue was centralised on the inaugural session. As we all know that our conference was successfully held at Patna from 26 th to 28 th December 2004. On this occasion we published an attractive souvenir. Two issues of the central organ 'Vigyan Shikshak' followed of which this is second.

The year 2005 is historic in the sense that it is the centenary year of the 'theory of relativity' propounded by the great scientist Albert Einstein who was awarded Ph.D. in the year 1905 from Jurich University. Various research institutes and academic organisations whether governmental or non-governmental are celebrating and organising different types of activities in the memory of the great scientist. It is the duty of every member of AISTA to participate in these activities.

The year 2005 also puts forward a task for us-**the preparation of the golden jubilee of our glorious organisation, AISTA.** It is known to all that AISTA was established in the year 1956 and so, the year 2006 will be the 50th year of our Association. We have to plan to celebrate the golden jubilee all over the country. We have to take steps from this very moment so that implementation is successful. This is a challenging task for us all.

We should keep in mind the suggestion of Einstein to the teachers that they should behave with their fellow students with love and generosity and not with harsh and unfair deal. "Teaching should be such that offering the gift of knowledge to the students is not a mere discharge of their duties."

Teaching Science

– *Prof. (Dr.) J. Thakur,* Vice-Chancellor,
Patna University, Patna.

People like me who started learning science forty five years ago and then made a career out of science teaching often ask ourselves if we have done a good job so that the students coming out today are better than they were when we started. No matter where we look, we always find that, on the average, the quality of teaching has gone down, especially in the imparting of experimental skills, without doubt there has been a great deal of expansion in the number of students coming out of schools and colleges but this is not surprising considering that the population has more than doubled in this very span of time. We have also come to appreciate and admire the bright young boys and girls who come out of the exceptionally good institutes like the I.I.T' s and other premier institutes. In this brief essay, I would like to make a few points about science education. I must point out that I have lived mostly in Bihar (except for the four and a half years doing Ph.D. abroad.) and naturally, what I shall say will be coloured and limited by my experiences.

There is concern in many quarters that good students are not coming into science stream. This point has been made by many at the level of the Union government and is not limited to Bihar. This is not what I want to talk about because I have not observed the implementation of science policies from close quarters in the Union government. It is the average science students who probably intend to join our schools and some colleges that I feel concerned about. Over the years there has been a sharp decline in the standards of impartation of scientific spirit and temper. I want to discuss three points here:

1. Our scientific education does not seek to arouse scientific curiosity. With new discoveries and inventions occuring at a breath-talking pace, it is necessary that our educators discuss the whys and hows of them. For example, these days medical diagnostic aids are freely used and most urban students have perhaps heard of terms like CAT, MRI, PET, ELISA etc, but very few students (and teachers not immediately concerned) are aware or even attempt to be aware of how these work. Very few schools and only a few colleges have functioning laboratories. Even where the infrastructure exists, laboratories seldom function because of non-availability of grants or lack of motivation on the part of teachers and students. Laboratories, field trips, visit to science museums all can play an important role in arousing curiosity which is ultimately what triggers the spirit of enquiry. Part of the purpose of doing experimental work in the laboratory is to learn to be disciplined and careful. They teach you how to do things and how not to do things. When you go around the city, you notice a hundred times that in a myriad little ways people are not behaving like they ought to (in their own interest). In modern life, there are a hundred occasions when discipline and cool thinking are needed. This is not to discourage adventure but to mention that suitable precautions are needed even there.

2. Our scientific education should promote skill development. As the country industrializes. it will need the services of many people with intermediate scientific skills. X-ray technicians. radiation experts, pathologists histopathologists, chemists, physicists, biologists and others with more specialized knowledge will all be needed and the consumers will expect quality work from them. Servicing of specialized equipment itself needs knowledge and understanding of basic principles. It is said that we are a country that values knowledge but not tinkering. In my opinion. this is a consequence of extreme poverty in villages. As more and more goods are becoming available, people are learning tinkering skills from changing flat tyre to fixing electric gadgets. In many cases "tinkerers" fix things without clearly understanding the Principles. But good "tinkerers" should understand the principle behind the instrument. Feynman in his book "Surely, you are joking Mr. Feynman" narrates an interesting story. When in high school in the thirties. he used to fix radio sets. of those days (based on electronic values since transistors were then not yet in use). Once he was taken to fix a radio that used to make a noise when turned on but the noise would die down after a while. At first he did not understand the reason, so he paced up and down the rooms, thought about it and eventually understood the exact reason behind it and then fixed it. He become famous as a "thinking repairman".

3. Promotion of scientific temper must be another aim. Late Sri Jawahar Lal Nehru, the first Prime Minister of India. used to talk very often about the need for people of India to develop scientific temper. By Scientific temper we mean the ability of people to judge issues on the basis of facts and reasonable standards without prejudice. I am not sure whether this definition is wholly adequte, or only appropximately so; my guess would be that, probably, the latter is true. In many cases, facts are not known fully, nor is it clear as to what constitutes reasonable standards because of cultural and other variations which makes it difficult to arrive at universal standards valid for all situations. Rationalism would appear to be one of the main requirements of a person with scientific temper but our world is so irrational in many ways that it is hard to expect rational responses in general. Scientific temper requires that our actions should follow our preferred beliefs and these in turn should be consistent with our understanding of science. Gautam the Buddha, said that one should not accept some statement because of the authority of its originator or some other person supporting it; rather one should analyse it and test it and then come to a conclusion. This constitutes the essence of scientific temper although in some cases this connot be carried out. The rapid advances in science in the last century (still continuing) make many prejudice difficult to hold on to. Ultimately, we shall develop and retain scientific temper only if it helps us prosper. There is a very good case that this is so.

These ideas are somewhat abstract and do not take into account the practical aspects of teaching science at primary, secondary or university levels. The difficulties are well known and can be summarized in the expression "Operation Black-board". Many schools do not even have a black board. The solution of these problems are complicated and require deep thinking and political consensus. At the moment, these seem difficult to achieve, even with the best intentions.

KRISHNAN MEMORIAL LECTURE :

रमन प्रभाव एवं लम्बी दूरी का संचार

- प्रो0 राजमणि प्रसाद सिंह

कुलपति

ललित नारायण मिथिला विश्वविद्यालय,

कामेश्वरनगर, दरभंगा

जब प्रकाश किसी माध्यम पर आपतित होता है तब निम्नलिखित प्रभाव अकेले या एक साथ इनमें कई हो सकते हैं :-

1. प्रकाश का माध्यम द्वारा अवशोषण
2. प्रकाश का परावर्तन
3. प्रकाश का वर्तन
4. प्रकाश का बिखराव **(Scattering)**
5. सम्पूर्ण परावर्तन
6. फोटो-एलेक्ट्रिक प्रभाव

अगर माध्यम की या अणुओं की संरचना कुछ इस प्रकार की हो कि **visible region** के प्रकाश को अवशोषण करने के लिये **energy level** मौजूद हो, तब प्रकाश का अवशोषण हो जाता है। और ऊर्जा या तो ताप में परिवर्तित होकर माध्यम को गर्म कर देती है या उसका **re-emission** होता है। अगर **energy level** अवशोषण के लिये उपलब्ध नहीं हो तो प्रकाश का माध्यम से **transmission** होता है । **(Fig.- 1)** ।

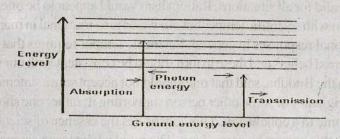



Fig. 1: Process of absorption an.. transmission.

साधारणतया शीशे से प्रकाश का **transmission** वर्तन **(refraction)** क्रिया द्वारा होना एक आम बात है परन्तु इससे प्रकाश के साथ-साथ ताप का भी **transmission** हो जाता है। इसके कारण शीशे लगे मकान एवं **A.C. car** में मौसम के प्रतिकूल एक खास तापमान को कायम रखना एक खर्चीला कार्य है। अभी-अभी **UCL** के शोध कर्त्ताओं ने **Vanadium dioxide** के एक **derivative** में एक विशेष गुण का पता लगाया है जिसमें **29°C** के नीचे **visible** एवं **infrared** दोनों ही प्रकार के प्रकाश **transmit** कर जाते हैं परन्तु इससे ऊँचे तापमान पर **infrared reflect** कर जाता है और **visible radiation transmit** कर जाता है। गर्मी **infrared radiation** के कारण उत्पन्न होती है। अत: गर्मी के दिनों में **29°C** के ऊपर तापमान होने पर घरों एवं **A.C.** कारों में सिर्फ प्रकाश पहुँच पायेगा परन्तु ताप नहीं, जिससे कम ऊर्जा के खर्च पर **A.C.** कार्य करेगा, परन्तु **29°C** के नीचे, प्रकाश एवं ताप दोनों पहुँच कर

कार को प्रकाशित एवं गर्म भी रखेगा। इस तरह ग्लास के **transmission** गुण में सुधार का व्यापक असर होगा यदि इस **material** का एक **coating** शीशे पर लगाया जाय तो इस प्रकार के शीशे की खिड़की **intelligent window** का कार्य करेगी । **Professor Ivan Parkin, University College of London, Department of Chemistry,** इस नये क्षेत्र में काम करने वाले ग्रुप के नेता हैं। यह **bound electron** के **29°C** के ऊपर **free** हो जाने के कारण होता है ।

अगर **electron** माध्यम में ढीले बंधन के अन्तर्गत हों (**threshold value** कम हो) तो प्रकाश की ऊर्जा उन्हें माध्यम से निकाल कर **space** में भेज देती है जिसके कारण फोटो इलेक्ट्रिक प्रभाव होता है ।

माध्यम **transparent** होने पर बाकी चार प्रभाव हो सकते हैं ।

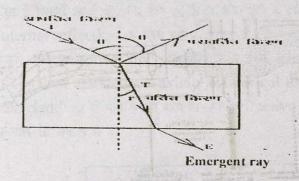



Fig. 2: Reflection, Refraction and Transmission of Light.

जब प्रकाश एक माध्यम से दूसरे transparent माध्यम में प्रवेश करता है तब reflection एवं refraction की क्रिया होती है। Reflection में आपतन का कोण परावर्तन के कोण के बराबर होता है, परन्तु वर्तन में

$$\frac{\sin i}{\sin r} = \mu = \text{a constant}$$ होता है ।

इसके साथ ही आपतित किरण, वर्तित किरण, परावर्तित किरण एवं आपतन बिन्दु पर डाला गया लम्ब सभी एक ही तल में होते हैं । **(Fig.- 2)**

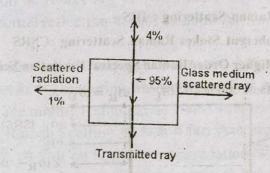



Fig.- 3: Scattering of Light

अगर माध्यम ग्लास हो और आपतन लम्बवत हो तो 4% प्रकाश परावर्तित तथा 95% प्रकाश वर्तित होता है एवं शेष 1% प्रकाश scattered कर जाता है जो किसी नियम को नहीं मानता है । (Fig.- 3)

यह 1% प्रकाश ही Raman effect को जन्म देता है। इस scattered radiation का 1% प्रकाश का रंग बदल जाता है, जो scattering medium के बारे में जानकारी देता है। **Scattering के कारण प्रकाश के रंग बदलने की प्रक्रिया को ही Raman effect कहते हैं ।**

0.01% intense Raman radiation को spectrograph पर photograph लेने के लिये विशेष व्यवस्था करनी पड़ती है । **(Fig.- 4)**

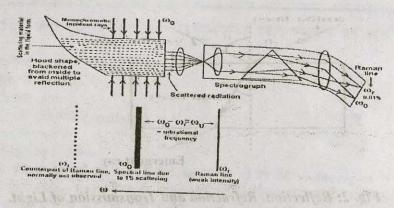



Fig. 4: Raman Effect

अगर एक तरह की किरणों के बजाय दो प्रकार की किरणों को transparent माध्यम पर एक दूसरे के साथ छोटे कोण बनाते हुए आपतित किया जाय एवं दोनों के frequency का अन्तर उस माध्यम के अणुओं की vibrational frequency के बराबर हो तो scattered radiation में wave mixing के कारण अनेक wave पैदा हो जाते हैं जिनकी frequency निम्नलिखित प्रकार की होती हैं :–

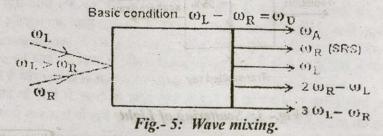
(i) $\omega_A = 2\omega_L - \omega_R \rightarrow$ **Coherent Anti - Stokes Raman Scattering : CARS**

(ii) ω_R= **Stimulated Raman Scattering : SRS**

(iii) ω_L= **Inverse Raman Scattering : IRS**

(iv) $2\omega_R - \omega_L \rightarrow$ **Coherent Stokes Raman Scattering :CSRS**

(v) $3\omega_A - 2\omega_R \rightarrow$ **Higher Order Raman Spectral Excitation Scattering : HORSES**

Fig.- 5: Wave mixing.

Carrier wave के माध्यम से ही विभिन्न प्रकार के audio-visual सम्वाद एक जगह से दूसरी जगह भेजा जाता है। Carrier wave की frequency ही संवाद की सीमा को तय करती है। अगर carrier wave, radio-wave region का हो तो सिर्फ sound wave का ही propagation होता है। अगर यह micro wave region का हो तो audio-visual दोनों ही प्रकार के सम्वाद को भेजा जा सकता है। यह अगर visible region का हो तो एक साथ पाँच हजार सम्वाद जा एवं आ सकता है ।

Visible region के radiation को लम्बी दूरी तक ले जाने के लिये विशेष व्यवस्था करनी पड़ती है और इसके लिये optical fiber का प्रयोग किया जाता है। यह fiber total internal reflection के सिद्धान्त पर आधारित है जिसमें ऊर्जा 99.99% तक reflect कर जाता है और इस तरह loss बहुत ही कम होता है। Total internal reflection के लिये यह आवश्यक है कि प्रकाश घने माध्यम से विरल माध्यम की ओर जाय। इसकी व्यवस्था optical fiber में किया जाता है जो core एवं cladding के रूप में व्यवस्थित होता है। Core एवं cladding co-axially cylindrical form में रहता है जहाँ core का refractive index, cladding से थोड़ा ज्यादा होता है। अगर refractive index 1.50 हो तो cladding का 1.48 के आस-पास रह सकता है ।

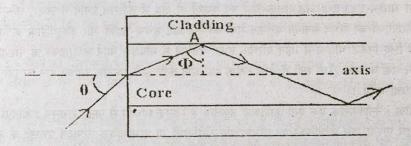



Fig. 6: Total internal reflection in optical fiber.

आपतन कोण θ इस प्रकार adjust किया जाता है कि Φ critical angle से ज्यादा हो ताकि total internal reflection की क्रिया A बिन्दु पर पूर्ण हो सके ।

इसी total internal reflection के कारण rainbow का fromation होता है एवं diamond में चमक आती है ।

अभी optical fiber को इतना improve किया जा सका है कि मीलों प्रकाश के गमन करने पर भी loss बहुत ही कम होता है। परन्तु scattering, absorption इत्यादि के कारण loss होता ही है। इसे make up करने के लिये wave mixing technique का इस्तेमाल किया जाता है ।

Stimulated Raman Scatting की क्रिया में बिना किसी तरह के परिवर्तन के ω_R की ऊर्जा बढ़ जाती है (Fig.5) और इस प्रकार on line power upgradation करना संभव है। इस प्रकार Raman Effect का प्रयोग communication में एक खास मकसद के लिये किया जाता है और इस प्रकार पूरे communication के अन्तर्गत रमन प्रभाव के रूप में कहीं न कहीं भारतीयता छिपी है । •

विज्ञान एवं (नैनो) तकनीक : सबों का सरोकार

- प्रो० रोहित रमण

विज्ञान और तकनीक : विज्ञान ब्रह्माण्ड के बारे में जानकारी हासिल करने की एक प्रक्रिया है। ब्रह्माण्ड के विभिन्न क्षेत्रों के संतुलन तथा गतिमान होना किन-किन नियमों तथा सिद्धान्तों पर आधारित है इसकी जानकारी की बढ़त ही विज्ञान की प्रगति के रूप में लक्षित होती है। विज्ञान को ज्ञान की वह शाखा माना जाता है जिसे प्राकृतिक तथ्यों एवं घटनाओं को वस्तुनिष्ठ तरीके से नियमानुसार अवलोकन तथा प्रयोगों द्वारा प्राप्त किया जाता है। विज्ञान वस्तु निर्भर ज्ञान है और इसका मूल काम है कार्य-कारण संबंध का पता लगाना, जगत में बगैर कारण कुछ नहीं होता। प्राकृतिक ही नहीं सामाजिक घटनाएँ भी नियम से बद्ध हैं ।

वैसे तो किसी भी काम को अंजाम देने का तरीका तकनीक ही कहा जा सकता है, लेकिन यहां हमारा तात्पर्य विज्ञान के व्यावहारिक रूप से है। तकनीक या टेक्नोलाजी या प्रौद्योगिकी ही वह माध्यम है जो विज्ञान को उपयोगी बनाता है, उसके मधुर फल यथा, रेल, तार, हवाई जहाज, दूरदर्शन, कंप्यूटर, मोबाइल आदि को मनुष्य के उपयोग एवं उपभोग के लिए बनाता चलाता है ।

भौतिकी के क्षेत्र में बीसवीं सदी की शुरूआत सापेक्षता और क्वान्टम-क्रांति के साथ हुई। परिणामत: नाभिकीय एवं अंतरिक्ष-युग का आरम्भ हुआ तथा अर्द्धचालक-जैसे नये पदार्थों के क्षेत्र में कल्पित प्रगति ने लेजर, कंप्यूटर, उपग्रह और अनेक दूसरी प्रौद्योगिकी को संभव बनाया। वर्त्तमान सदी की शुरूआत सूचना-क्रांति और आनुवंशिक क्रांति से हुई है जिसका हम सबों के लिए निकट भविष्य में गहन परिणाम होगा, वर्त्तमान में मोबाइल फोन फोटोग्राफी के परिणामों से हम दो-चार हो रहे हैं। इन सबों के साथ 21वीं सदी में नैनोतकनीक एक अति क्रांतिकारी तकनीक साबित होने जा रही है जिसकी संक्षेप में हम नीचे चर्चा करेंगे ।

नैनोतकनीक : नैनोतकनीक एक ऐसी क्रांतिकारी तकनीक है जिसके माध्यम से मानव सचमुच इंजीनियरी के सबसे आखिरी छोर पर पहुंच पाएगा। इस प्रौद्योगिकी को परमाणविक इंजीनियरी या परमाणविक उत्पादन प्रणाली के नाम से भी जाना जाता है। ऐसे भविष्य की कल्पना कीजिए जब कंप्यूटर अधिक तेजी से काम करेंगे। स्टील से भी हल्के व सौ गुणा अधिक मजबूत पदार्थ तैयार होंगे और कैंसर, पार्किंसन और एड्स जैसी बीमारियों का इलाज खास किस्म की चिकित्सीय हिकमत से हो सकेगा। यह किसी विज्ञान-कथा की कोरी फंतासी या कल्पना नहीं, बल्कि अणुओं और परमाणुओं के स्तर पर कार्य करने वाली नैनोतकनीक से यह सभी संभावनाएं हकीकत में बदल सकती है। दरअसल, अतिसूक्ष्म आकार के कणों के विज्ञान को ही नैनोविज्ञान की संज्ञा दी जाती है। चूंकि टेक्नोलाजी या प्राद्योगिकी विज्ञान को उपयोगी बनाने का एक माध्यम है। नैनोतकनीक नैनो विज्ञान का ही व्यावहारिक रूप है ।

नैनो : नैनो शब्द ग्रीक भाषा के 'नैनोज' से निकला है। इसका अर्थ है बौना लेकिन मापने के संदर्भ में नैनो एक अरबवें हिस्से (10^{-9}) को निरूपित करता है। जैसे एक नैनोमीटर का अर्थ है- एक मीटर का एक अरबवां हिस्सा। नैनोमीटर कितना सूक्ष्म है, इसका अनुमान इस बात से लगाया जा सकता है कि यह महज एक आलपिन की नोक के दस लाखवें हिस्से के बराबर होता है। इससे आप यह अंदाजा लगा सकते हैं कि नैनो तकनीक में कितने सूक्ष्म स्तर पर कार्य किया जाता है।

नैनो कण व नैनोपदार्थ : नैनोस्तर पर परमाणु मिलकर गुच्छों यानी क्लस्टर की सृष्टि करते हैं। ऐसे गुच्छों को नैनो कण, क्वांटम डाट, क्यू कण आदि की संज्ञा दी जाती है। एक गुच्छ का व्यास अमूमन एक से लेकर 100 नैनोमीटर के बीच होता है। हालांकि ये गुच्छ अणुओं की तुलना में काफी बड़े होते हैं। लेकिन स्थूल पदार्थ की तुलना में आकार में ये काफी सूक्ष्म होते हैं। अत: इनसे एक नये ही किस्म के पदार्थ की सृष्टि होती है। इसे ही नैनो पदार्थ कहते हैं ।

नैनो पदार्थ एवं भौतिक नियम : पिछले करीब दो दशकों में नैनो पदार्थ के व्यवहार को समझने हेतु किये गये शोध-अध्ययनों से विज्ञानियों को यही लगता है कि न तो क्वांटम यांत्रिकी और न सनातन (क्लासिकल) भौतिकी के नियमों से ही इन पदार्थों के व्यवहार को समझा जा सकता है। संभवतया नैनो पदार्थ के संसार को क्वांटम यांत्रिकी तथा सनातन भौतिकी के सम्मिलित नियमों से ही समझ पाना संभव है। बहरहाल यह पाया गया है कि :

(i) नैनो स्तर पर वैद्युत एवं तापीय चालकत्व दोनों ही क्वांटित (क्वांटराइज्ड) हो जाते हैं ।

(ii) *'कूलॉम आइलैंड'* नामक एक खास चालक से होकर गुजरने वाले इलेक्ट्रॉन बड़े ही अनुशासित हो जाते हैं, वे बारी-बारी से उस चालक से होकर गुजरते हैं ।

इस घटना को विज्ञानियों ने 'कूलॉम ब्लाकेड' का नाम दिया है और इन्हें कुछ अनुप्रयोगों में भी लगाया है। इस तरह एकल इलेक्ट्रॉन ट्रांजिस्टरों के निर्माण में भी उन्हें सफलता मिली है ।

सूक्ष्म मशीन : नैनोतकनीक के प्रयोग से सूक्ष्म मशीनों, सूक्ष्म युक्तियों आदि का निर्माण तो किया ही जा सकता है, कई वस्तुओं जैसे कि वस्त्र, टेनिस की गेंदे, कृषि उपयोगी उत्पादों आदि के विकास में भी इस तकनीक की अहम् भूमिका हो सकती है। खास किस्म के नैनो कणों के इस्तेमाल से ऐसी पतलूनें बनाई गई हैं जिन पर दाग-धब्बों का कोई असर नहीं होता है। ऐसे वस्त्रों को तैयार करना भी संभव हुआ है जिन पर सलवटें नहीं पड़ती हैं। नैनो प्रौद्योगिकी के प्रयोग से मजबूत वस्त्रों के निर्माण में भी कुछ हद तक सफलता मिली है ।

इस संदर्भ में *'टाप डाउन'* और *'बाटम अप'* तकनीक का उल्लेख करना संगत होगा ।

अणुओं व परमाणुओं का अवलोकन तथा उनके द्वारा नैनो संरचनाओं की सृष्टि करने के लिए वैज्ञानिकों ने विशेष सूक्ष्मदर्शियों का निर्माण किया है। स्केनिंग टनलिंग माइक्रोस्कोप (एस टी एम) और एटॉमिक फोर्स माइक्रोस्कोप (ए एफ एम) ऐसे सूक्ष्मदर्शियों के व्यावहारिक उदाहरण हैं जिसकी मदद से नैनो युक्तियों के विकास में बड़ी मदद मिलती है ।

उल्लेखनीय है कि नैनो स्तर की संरचनाओं की सृष्टि के लिए वैज्ञानिकों ने साफ्ट लिथोग्राफी और 'डिप पेन' लिथोग्राफी (जिसमें एटॉमिक फोर्स माइक्रोस्कोप (ए फ एम) इस्तेमाल किया जाता है) नामक तकनीकों का भी विकास किया है। इन तकनीकों को वैज्ञानिकों ने 'टाप डाउन' निर्माण विधियों का नाम दिया है क्योंकि इनसे बड़े स्तर से शुरू करके नैनो स्तर की संरचनाओं का सृजन किया जाता है। विशेषकर नैनो स्तर पर इलेक्ट्रानिक युक्तियों के विकास के लिए इन विधियों का इस्तेमाल किया जाता है ।

लेकिन वैज्ञानिकों ने इन विधियों को उतना कारगर नहीं पाया है और न ही सुविधाजनक व सस्ता ही। अत: 'बाटम अप' तकनीक, जिसमें परमाणुओं और अणुओं के स्तर से उपर उठते हुए नैनो संरचनाओं की सृष्टि की जाती है, में वैज्ञानिकों ने अपनी दिलचस्पी दिखाई है। इसमें परमाणुओं के स्व-समायोजन (सेल्फ असेंबली) के गुणधर्म का इस्तेमाल किया जाता है। इस तकनीक द्वारा दो से लेकर 10 नैनोमीटर तक की नैनो संरचनाओं की सृष्टि सफलतापूर्वक की जा सकती है। इसी 'बाटम अप' तकनीक द्वारा वैज्ञानिकों को नैनो टयूब तथा क्वांटम डाट नामक विशिष्ट नैनो कणो के विकास में सफलता मिली है। इसके प्रयोग से बहुत कम ऊर्जा और कच्चे माल की आवश्यकता होती है और इससे कम प्रदूषण की सृष्टि भी होती है ।

नैनो ट्यूब कार्बन परमाणुओं से बनी खोखली नलिकाओं के आकार की होती है जिसका व्यास लगभग एक नैनोमीटर होता है। जापान की एनईसी फंडामेंटल रिसर्च लेबोरेटरी से संबद्ध **सुमिओं ईजीमा** ने ही पहले-पहल 1991 में कार्बन की इन खोखली नलिकाओं की खोज की थी ।

नैनो तकनीक : विविध उपयोग : नैनो ट्यूबों का इस्तेमाल सूक्ष्म रोबोटों, डेंटरोधी कारों (जिन पर खरोंच आदि के निशान नहीं पड़ते हैं) तथा भूंकपरोधी भवनों आदि के निर्माण में किया जा सकता है। इसके अलावा इलेक्ट्रानिक व नैनो युक्तियों के विकास में भी इनका इस्तेमाल होता है। नैनो ट्यूबों की मदद से ट्रांजिस्टरों व नैनो तारों को बनाने के अलावा ऐसे नैनो परिपथों का निर्माण करना भी संभव हुआ है जिनमें तार, स्विच और स्मृति अवयव आदि सभी का काम नैनो टयूबों या अन्य परमाणुओं द्वारा ही लिया जाता है। नैनो टयूबों से होकर इलेक्ट्रानों के इन विचित्र गुणधर्म का इस्तेमाल 'स्पिनट्रानिक' युक्तियों के विकास में किया जा सकता है ।

नैनो कणों के भी अनेक उपयोग हैं। इनसे मजबूत फिल्में बनाई जा सकती हैं। इन फिल्मों को कार विंडशील्ड, हेडलाइट आदि की सतह पर चढ़ाकर उन्हें खरोंच आदि से बचाया जा सकता है। नैनो कणों से विशेष किस्म के उत्प्रेरक भी बनाए जा सकते हैं। पर्यावरण संबंधी अनुप्रयोगों में इन उत्प्रेरकों से विशेष काम लिए जा सकते हैं। नैनो कणों द्वारा पराबैंगनी किरणों का अवशोषण भी अधिक हो जाता है। अत: नैनो कणों से बनी फिल्मों को खिड़कियों के शीशों, कार विंडशील्ड आदि पर चढ़ाकर पराबैंगनी किरणों के घातक असर से बचा जा सकता है। नैनों कणों से तैयार की गई स्याही का प्रकाश घनत्व अधिक होता है। अत: स्याही को इंगजेट मुद्रण में इस्तेमाल करने पर चित्रों के रंगों में बहुत अच्छे प्रभाव देखने को मिलते हैं। यही नहीं बल्कि नैनो स्याही के इस्तेमाल से प्रिंटहेड भी लंबी अवधि तक काम देता है ।

कुछ विशेष नैनों कणों को क्वांटम डाट का नाम दिया जाता है। आमतौर पर कैडमियम सेलिनाइड जैसे अर्द्धचालकों से ही इनका विकास किया जाता है। लेकिन विकास की प्रक्रिया में क्वांटम डाट नामक नैनों कणों में एक विशिष्ट गुणधर्म का समावेश हो जाता है जो अर्द्धचालकों में नहीं पाया जाता। अर्द्धचालक पदार्थ केवल कुछ खास आवृत्ति (या तरंगदैर्ध्य) वाले फोटोनों (Photons) का ही उत्सर्जन कर सकते हैं। लेकिन क्वांटम डाटों से उत्सर्जित होने वाले प्रकाश का तरंगदैर्ध्य (या रंग) उनके आकार पर निर्भर करता है। अत: विभिन्न आकार के क्वांटम डाट विभिन्न रंगों वाले प्रकाश का उत्सर्जन कर सकते हैं। क्वांटम डाट के उल्लिखित गुण का जैव अनुप्रयोगों में बखूबी इस्तेमाल किया गया है। प्रोटीन और न्यूक्लीय अम्लों आदि की पहचान के लिए क्वांटम डाटों का प्रयोग जैव लेबलों की तरह किया जा सकता है। क्वांटम डाटों द्वारा प्रकाशीय सूचनाओं का भंडारण भी संभव है। क्वांटम डाटों को लेकर इस तरह की और भी युक्तियों के विकास की दिशा में विश्व भर में पूरे जोर-शोर से प्रयास चल रहे हैं ।

नैनोतकनीक द्वारा टेनिस की ऐसी गेंदों को तैयार किया जा सकता है जो काफी इस्तेमाल के बाद भी टप्पा खाने के अपने गुणधर्म को बरकरार रखती है। नैनो सिरामिक और नैनो पालिमरों से बने पदार्थों से वाहनों के लिए ऐसे टायरों का निर्माण हो सकेगा जो इस्तेमाल से बहुत कम घिसेंगे। इस तरह न केवल टायरों की आयु को बढ़ाया जा सकेगा बल्कि वातावरण में टायरों के सूक्ष्म कणों के उड़-उड़ कर बिखरने से उत्पन्न दुष्प्रभावों से भी काफी हद तक बचा जा सकेगा ।

नैनोतकनीक के इस्तेमाल से बहुत ही हल्के व मजबूत नैनो-समिश्र पदार्थों का निर्माण भी किया जा सकेगा। ऐसे पदार्थों के इस्तेमाल से वाहनों के आकार को छोटा और उसके वजन को काफी कम किया जा सकेगा। इससे वाहनों की ईंधन की खपत भी कम हो जाएगी। खासकर अंतरिक्ष यानों के निर्माण में ऐसे समिश्र पदार्थों की महत्त्वपूर्ण भूमिका होगी। अंतरिक्ष यानों के आकार और वजन में न केवल अभूतपूर्व कमी आयेगी बल्कि उनकी ऊर्जा की आवश्यकता भी काफी हद तक कम हो जायेगी ।

कृषि के क्षेत्र में नैनोतकनीक के प्रयोग द्वारा जैवनिम्नीकरणीय उर्वरकों तथा कीटनाशकों का निर्माण संभव हो सकेगा। साथ ही साथ ऐसे कृषि उपकरणों और संवेदकों का भी विकास हो सकेगा जिनकी मदद से कृषि उपज बढ़ाई जा सकेगी ।

चिकित्सा के क्षेत्र में भी नैनोतकनीक अत्यधिक उपयोगी साबित हो सकती है। इस प्रौद्योगिकी से ऐसे नैनो मशीनें बनाना संभव होगा जो रक्त परिसंचरण प्रणाली के जरिए बीमार या कैंसरग्रस्त कोशिकाओं तक पहुँच कर उन्हें नष्ट करेंगी या फिर क्षतिग्रस्त ऊतकों की मरम्मत कर उन्हें फिर से स्वस्थ बनाएंगी। ड्रग डिलिवरी प्रणाली के लिए कार्बन नैनो टयूबों का इस्तेमाल बीमारियों के रोग निदान में भी संभव है ।

नैनोतकनीक के प्रयोग से ऐसे विशेष फिल्टरों का निर्माण भी संभव हुआ है जिनके छिद्रों का आकार 10 से 100 नैनोमीटर तक होता है। पेट्रोल और डीजल में मौजूद अतिसूक्ष्म कणों को हटाने में इन नैनो फिल्टरों का इस्तेमाल किया जा सकता है ।

दरअसल जीवन के लगभग सभी पहलुओं को प्रभावित करने की क्षमता नैनोतकनीक में है। निसंदेह नैनोतकनीक 21वीं सदी की एक अति क्रांतिकारी प्रौद्योगिकी साबित होगी ।

• **नैनोतकनीक : भारत व विश्व :** नैनोतकनीक के क्षेत्र में अपार संभावनाओं को देखते हुए अमेरिका, जर्मनी, जापान और ब्रिटेन जैसे विकसित देशों ने इस क्षेत्र में अनुसंधान के द्वारा खोल दिए हैं। चीन और रूस भी पिछले एक दशक

से नैनोतकनीक के क्षेत्र में अनुसंधान कर रहे हैं। अन्य राष्ट्रों की देखादेखी सिंगापुर, दक्षिण कोरिया और ताइवान ने भी पिछले कुछ वर्षों से इस क्षेत्र में अनुसंधान पर ध्यान केंद्रित करना आरंभ किया है ।

भारत में भी नैनोतकनीक पर कुछ कार्य चल रहा है। इस क्षेत्र में भारतीय अनुसंधान के प्रणेता **सी एन आर राव** हैं। **डी आर डी ओ** सहित कुछ अन्य संस्थानों में इस दिशा में कुछ अनुसंधान हो रहा है। दिल्ली विश्वविद्यालय के रसायन विशेषज्ञों ने आर्गेनिक पालीमर के बने नैनोकणों का विकास किया है जिनका उपयोग ड्रग डिलिवरी प्रणाली में किया जा सकता है ।

इंडियानैनो नामक एक ग्लोबल फोरम की स्थापना भी हुई है जो सरकारी व गैर-सरकारी प्रयोगशालाओं, निवेशकों व उद्यमियों आदि को नैनो स्तर पर अनुसंधान और विकास कार्य के लिए आर्थिक अनुदान मुहैया कराती है। मुंबई में भी **यश नैनोटेक** नामक कंपनी इस दिशा में कार्यरत है। लेकिन नैनोतकनीक में मूलभूत अनुसंधान और विकास के लिए सरकारी पहल और वित्तीय सहायता एक बहुत जरूरी शर्त है ।

विज्ञान, तकनीक और समाज : यद्यपि आज विज्ञान को अपनी सफलताओं पर गर्व है तथापि वह ज्ञान के उस लम्बे चौड़े और सदा फैलते हुए समुद्र के आगे सर झुकाता है जो अभी तक अनखोजा पड़ा है। बुद्धिमान आदमी महसूस करता है कि उसका ज्ञान कितना तुच्छ है, सिर्फ मूर्ख ही समझता है कि वह सब कुछ जानता है। शायद यह कहना सही हो कि विज्ञान की प्रगति का माप यह नहीं है कि हम कितने सवालों के उत्तर दे सकते हैं, बल्कि यह है कि हम कितने सवाल पूछ सकते हैं। पर फिर भी विज्ञान तो दिन-पर-दिन ज्यादा ही सवालों के उत्तर देता जा रहा है, और जीवन व ब्रह्माण्ड के रहस्य समझने में हमारी सहायता कर रहा है। आज इस बात पर किसे संदेह है कि किसी सवाल पर गौर करने का सही तरीका सिर्फ विज्ञान का तरीका ही हो सकता है? और, इस वैज्ञानिक मानसिकता हेतु आवश्यक है कि हम अपने चतुर्दिक विज्ञान द्वारा लाये जा रहे परिवर्त्तनों एवं खुद अपने जीवन में उसके सकारात्मक योगदान से वाकिफ हों। तभी हम उसका समुचित उपयोग कर सकेंगे, उसमें अन्तर्निहित नकारात्मक प्रभावों से बच सकेंगे और समाज की आर्थिक-राजनीतिक संरचना में वांछित परिवर्त्तन हेतु सचेष्ट हो सकेंगे। विज्ञान की वजह से ब्रह्मांड, समाज और अपने बारे में हमारी धारणायें तेजी से बदल रही है; विज्ञान की प्रगति ने मनुष्य की चेतना को निश्चित रूप से बदला है और बदल रहा है ।

विज्ञान की प्रगति उपयोगी के साथ-साथ अनुपयोगी प्रौद्योगिकी के आविर्भाव का कारण बना है। यहां यह उल्लेख संगत होगा कि वैज्ञानिक ज्ञान किसी समाज अथवा देश के शासक वर्ग की आवश्यकता के मद्देनजर और साधनों की उपलब्धि के अनुसार प्रौद्योगिकी के उभरने में योगदान देता है, जिसे अपनाया जाता है। जबतक हमारी आर्थिक-राजनीतिक संरचना का लक्ष्य सबों की स्वतंत्र प्रगति न हो तबतक विज्ञान की प्रगति के सकारात्मक उपयोग के साथ-साथ विध्वंशात्मक आयामों का भी खतरा मानव जाति पर मंडराता रहेगा जैसा कि सम्प्रति है। आज हमारे जीवन का कोई भी पहलू प्रौद्योगिकी से अछूता नहीं है ।

मौजूदा अनियंत्रित आर्थिक विकास, जिसके कार्यान्वयन में विज्ञान की एक महत्वपूर्ण भूमिका रही है, के कारण विश्वव्यापी उष्णता, ओजोन परत की क्षीणता, वायु-जमीन-पानी का व्यापक प्रदूषण तथा पर्यावरण से जुड़ी अनेक समस्याओं का जन्म हुआ है जो मानव जाति के अस्तित्व के लिए खतरे बन गये है। अतः यह आश्चर्यजनक नहीं कि पृथ्वी ग्रह की सेहत में गिरावट के लिए विज्ञान को भी दोषी ठहराया जाता है। अब विज्ञानियों का ध्यान संसाधन के दोहन के बजाय संसाधन के प्रबंध की ओर ज्यादा है। परन्तु ऐसा करने में वे इस दोष को स्वीकारते दीखते हैं कि विज्ञान भी राजनीतिज्ञों, जो दशकों से बेरहमी से संसाधन-दोहन की नीति अपनाते रहे हैं, के साथ स्वैच्छिक सहापराधी रहा है ।

असंदिग्ध रूप से विज्ञान समाज का एक अति उपयोगी संस्था है। यह रूढ़िवाद और अन्धकार-युग की विशेषता प्रदर्शित करने के खिलाफ समाज का बीमा है। वैज्ञानिक वादविवाद का खुलापन, वैज्ञानिक तरीकों का तर्क व तर्क-संगति पर भरोसा ही विज्ञान की शक्ति है और यह संतोष की बात है। विज्ञान में अन्तर्निहित प्रक्रिया यह सुनिश्चित करने की कि कोई सिद्धान्त अचूक नहीं, दुनिया की समझ हेतु वैज्ञानिक तरीकों की उपयोगिता में हमारे भरोसा को बढ़ाता है। विज्ञान मानवीय कोशिश की एक अमूल्य उपलब्धि है। बौद्धिक गतिहीनता के खिलाफ बीमा के रूप में विज्ञान को हृदय में संजोना है। विज्ञान हमारे जीवन को सिर्फ भौतिक दृष्टि से ही नहीं बल्कि आध्यात्मिक रूप से भी बदल रहा है। प्रौद्योगिकी हमारी मनोवृति और मूल्यों को भी शक्ल प्रदान कर रही है। विज्ञान को सामान्यजन के लिए बोधगम्य बनाना है ।

शेष पृष्ठ 18 पर ......

A STUDY ON SOME MISCONCEPTIONS IN PHYSICS THEIR CAUSES AND REMOVAL

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[Abstract : Over emphasis on mathematics while teaching and learning physics at +2 level and physical science at secondary level develops some misconceptions. Author investigates some misconceptions and their causes, and also suggests some plausible remedial measures.]

1. Introduction :

Every science subject comprises a large number of concepts. Teaching and learning become meaningful when children acquire these concepts. When a child becomes able to state the characteristics of a scientific term in different possible ways and can connect the term with others, s/he attains the concept of the term. One can not gain concept of force by observing the moving bodies but can gain the same by studying the effect of force on different bodies under different conditions. Similarly just by seeing a leaf of a plant one can not form concept of leaf. When one follows the structure, function and composition of a leaf and finds its role with respect to the whole plant in different situation only then can form the concept of leaf.

2. Uses of concept :

Without going into formal definition of concept we may list some important uses of it. Concept helps to

(i) distribute knowledge of a subject into several meaningful groups.

(ii) integrate and correlate different terms of same or different subjects.

(iii) have comprehensive idea about the whole subject.

Concept teaching and learning in science require precision. Again careless attempt and illogical analysis may culminate to misconception. We shall consider here some misconceptions particularly in physics. caused by careless use of mathematics in teaching and learning.

3. Misconceptions in Physics :

Concepts in physics are sometimes confused with mathematical relations or equations. In physics verbal statement, discussion, description etc. (qualitative aspect) exist side by side with different mathematical relationships (quantitative aspect). This has given physics a unique objectivity in the family of science. When the teaching/learning of physics is not equally or judiciously ditributed over qualitative and quantitative aspects physics teaching/learning becomes defective and is not conducive to attain concept. Sometimes due to over emphasis of mathematics in physics students use mathematical relationships in the name of concept. This is highly undesirable.

3.1. Some prototype questions on concepts :

For setting items on concepts generally following formats are used :-

- What is X ?
- What do you mean by X ?
- What are the characteristics of X ?
- What are the salient features of X ?
- How does X differ from Y ?
- What are the essential similarities between X and Y ?
- Show that X depends on Y, Z, etc.
- Show that X is a function of Y, Z etc.
- Show that X can be represented by Y under certain conditions. [X, Y, Z etc. are some concepts.]

3.2. Survey on Misconceptions in Physics.

For estimating the concept development among the students, questions of above types were asked by the author to the students from primary to higher secondary levels. The students, mostly under-achiever, instead of giving conceptual answer mentioned only some mathematical relationships.

EXAMPLES

3.2.1. Concept of volume : (Primary level)

Questions : What is the volume of a body ?

Answer : Volume is the product of length , breadth and thickness. The answer relates to measurement of volume and is intended to measure the volume of a parallelopiped. It is not at all the concept of volume. Volume is taught at different classes as follows according to the need of different classes.

(i) Volume of a body is its capacity to hold material.

(ii) Every object has volume.

(iii) Body of any shape has volume.

(iv) Volume is three dimensional.

(v) Two volumes may be equal or unequal and may be added like scalar quantities.

(vi) In space we can imagine volume.

(vii) A solid body has one type of volume only.

(viii) Hollow body has both external and internal volumes.

(ix) Volumes of different shapes and sizes can be measured.

(x) Shadow has no volume etc.

Different teaching approaches to understand and measure volume may be used.

3.2.2. Concept of force (class IX)

Questions : What is force ?

Answer : Force is the product of mass and acceleration of a body. Where as the qualitative aspect of concept of force is given by Newton's first law of motion and the quantitave aspect (i. e. magnitude and direction) is given by the second law, the students' above noted answer only relates to measurement of force.

3.2.3. Refractive Index (class IX)

Q. What is the R. I. of a medium ?

A. $RI = \frac{\sin i}{\sin r}$ Where i and r are angles of incidence and refraction respectively.

In the above answer i and r are not the property of medium. They help to measure the RI of a medium. So the above answer does not represent the concept of RI. RI, essentially a relational concept, is the ratio of velocity of light in vacuum to that in the medium.

3.2.4. Concept of work (class XI)

Qus. What is work ?

Ans. Work is the product of force and distance.

Student used 'distance' in lieu of correct form "displacement". However the above answer does not represent the concept of work: it helps simply measuring the work done. Again if the relation is accepted as the concept of work, it may be confused with moment of force or torque [moment of force is also the product of force and distance] For the development of the concept of work we may present the following clues.

(i) Work is done when the point of application of force is displaced.

(ii) When the angle (A) between force and displacement is less than 90^{0}, work is done by a force.

(iii) When $A>90^{0}$ work is done against a force.

(iv) In a field of force work done against the field is treated as positive.

(v) Work is a scalar while torque is a vector quantity.

3.2.5. Concept of Electrical Resistance (class XI)

Qus. What do you mean by electrical resistance ?

Ans. Resistance = Potential Diff ÷ Current

Does the above answer reveal anything about characteristics of electrical resistance? Why are the resistances of different conductors not same under identical shape, size and physical conditions ? Why are the resistances of the same conductor but of different shape and size not same ? All these remain unanswered in the above answer.

The above relation will indicate only the relation between current and PD, and provides a way for the measurement. Mathematician will say that resistance is the slope of current—PD curve. But that does not give any clue to the development of resistance in a conductor. So the concept of resistance will never be clear unless we discuss.

(i) Process of development of resistance in an electrical conductor.

(ii) Factors controlling resistance of a conductor.

(iii) Under identical physical conditions resistace of different conductors are different.

(iv) Resistance can be added linearly in some cases.

(v) Solid, liquid and gas-all offer electrical resistances of different extent under different conditions.

3.2.6. Concept of Moment of Inertia (class XI)

Qus. What is the role of moment of inertia in rotational motion ?

Ans. Moment of inertia is equal to product of mass and square of radius of gyration of a body in rotational motion.

• Perhaps the role is not sufficiently revealed by the formula as mentioned above. It would be rather more convincing if we can reveal how the rotational motion depends on MI. So the students should understand that.

(i) MI is considered to play the same role in rotational motion as do the 'mass' in linear motion. So MI may be termed as 'rotational inertia'.

(ii) In linear motion the inertia depends on mass only where as in rotational motion it depends on mass and radius of gyration.

(iii) So it is inevitable that moment of inertia will depend on mass and radius of gyration.

(iv) MI, therefore, also depends on mass and shape of the body as well as the position and orientation of rotational axis.

4. How does this unfortunate situation occur ?

4.1. Proper balance between qualitative and quantitative aspects seems to be almost absent in physics or physical Science curriculm. [More emphasis on qualitative aspect of physics is given at secondary level and on mathematical or quantitative aspects at H.S. level.]

4.2 Plug-in type numerical problems are not helpful for concept development.

4.3 Liberal uses of life-centric experiences, examples, activities etc. seem to be wanting.

4.4 Critical problems, paradoxes and sophism are not adequate in the curriculum.

4.5 Extra reading is not always encouraged.

4.6 Questions and cross questions are rarely used in classroom.

4.7 Teaching and learning are mostly examination-oriented, Questions asked are mostly repetitive type (repetition of the questions of previous years) Or knowledge type. Understanding and application type questions are absent in a spectacular way.

4.8. Co-curricular activities are seldom organised to develop the horizon of experiences of the students.

4.9. Where as Mathematics should be used as means, it is frequently used as an end.

4.10. In H.S. Physics numerical problems are still now believed to be the best way for development of concepts.

5. How to overcome the Situation ?

Within the framework of curriculum, time and competencies of the students and teachers concepts may be developed among the students by slightly changing the strategies of teaching and learning as noted below.

More emphasis is to be given on :—

5.1. Problem oriented questions.

5.2. Use of examples, reasoning, comparisons, flow diagrams, concept mapping, explanation, analogy, home-assignment (in terms of activities), reading reference books and science fictions etc.

5.3. Performing experiments at any place with easily available materials and performing open ended experiments.

5.4. Qualitative as well as quantitative aspect of each concept in a balanced way.

5.5. Children's own concepts (also known as alternative concept, own observation, divergent thinking etc) [Alternative concepts may be modified by the teacher, if necessary].

5.6. Use of small numerical or diagrammatic problems.
5.7. Use of paradoxes and sophism.
5.8. Hypothesis to be formulated by the students for solution of a problem.
5.9. Psycholinguistic clarity of meaning of different terms. (e.g.)
Prism in mathematics and optics.
Polarisation in electicity and optics.
Work in daily life and in physics.
Induction as electric and magnetic phenomenon and induction as a physical quantity.
Force and energy and their distinction.
Weight and force due to gravity.
Tangent in geometry and tangent in trigonometry.
Normal in chemistry and normal in optics.
Moment used in different senses in physics.
Degree in mathematics and in physics.
Pitch used in different senses in physics.
(pitch of a screw, pitch of a sound).
Divergence in mathematics and optics etc.

पेज न० 13 का शेषांश ....

वर्गीय शोषण से मुक्त समाज में ही विज्ञान का इस्तेमाल मुनाफा कमाने हेतु न होकर जनकल्याण के लिए होगा। ऐसे समाज में विज्ञान और उद्योग दोनों के लिए अपार संभावनाएं निहित हैं। वर्तमान मानव जीवन में पाए जाने वाली निराशा, अकेलापन, अलगाव, पीड़ा, विवशता के लिए कुछ लोग विज्ञान को दोषी ठहराते हैं। यह सच नहीं है। वर्गीय व्यवस्था इसके लिए जिम्मेदार है। यदि ऐसा न होता तो सामंती समाज के प्रारंभिक दौर में शोषण नहीं होना चाहिए था। क्योंकि उस समय व्यक्ति वैज्ञानिक ज्ञान से शून्य एवं धर्म पर पूर्णतया आश्रित था। व्यक्ति शोषित आज भी है, लेकिन साम्ंती शोषण से गुणात्मक रूप से भिन्न हैं, क्योंकि आज शोषित वर्ग इस चेतना के साथ जीता है कि वह शोषित है। यही चेतना उसकी मुक्ति का रास्ता खोलेगी और विज्ञान व तकनीक की भूमिका मानव कल्याण में सेतु बनेगी।

1. लेखक पटना विश्वविद्यालय में भौतिक शास्त्र के प्राध्यापक, 'अध्ययन एवं शोध केन्द्र", पटना- 800016 के निदेशक तथा भौतिक शास्त्र के कई उच्च स्तरीय पुस्तकों के लेखक हैं। सम्पर्क पता : D-301, चारमीनार एपार्टमेन्ट, रोड न०-12, राजेन्द्रनगर, पटना-800016, दूरभाष: 0612-2673772

2. उपर्युक्त आलेख आल इंडिया साईंस टीचर्स एसोसिएशन के 39वें सम्मेलन में चर्चा हेतु हमारे अनुरोध पर प्रो. रोहित रमण के द्वारा तैयार किया गया था। किंतु, सम्मेलन प्रारंभ होने की पूर्वरात्रि से ही उनके अस्वस्थ हो जाने के कारण इसपर सम्मेलन में चर्चा नहीं हो पायी। अत: अपने पाठकों के लाभार्थ इस आलेख को हम सम्मेलन में शामिल आलेख के रूप में ही यहां प्रकाशित कर रहे हैं। -संपादक

The Concept of sustainable development and the role of Science Education

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Preamble

Sustainable development is a new concept that took shape during the conservation/environmental movement of the 1970's. This term links the concepts of society, environment, economy, development and includes the questions about how human decisions affect the Earth's environment. Sustainable development occurs when we acknowledge the relationship between human needs and their habitat i.e. the natural environment.

Meta-analysis

The concept of sustainable development was discussed in the United Nations Conference on the Human Environment in Stockholm in 1972, which considered the need for a common outlook and for common principles to inspire and guide people of the world in the preservation and enhancement of the human environment. In the same year the magazine "The Ecologist" published what was called "A blueprint for survival". Since then there have been a number of reports which indicate a preoccupation with developing a positive attitude and fostering respect towards preserving the environment, cultural traditions, indigenous values and ways of life [1]. In 1992 at the Earth Summit in Rio de Janeiro, during the discussion on how to achieve sustainable development, a plan of action (agenda 210 was agreed upon and there was a recommendation that all countries should produce national sustainable development strategies [2]. Yet most people in the world today sense the danger that the Earth's capacity for regeneration is on the verge of being exhausted. As a consequence of rapid economic expansion under globalisation at any cost particularly in South and South-East Asia, severe environmental and ecological degradation and loss of biodiversity has occurred pushing various species to the brink of extinction. The UN states that 11046 species of plants and animals are currently endangered. These include 1,130 species of mammals and 1,183 species of birds as well as 5,611species of plants. If the current trends in species extinction continues we may lose half of all earth's plant and animal species in just 50 years time. Half of the world's original forest cover has now been destroyed. Over 45% of tropical moist forests and approximately 70% of tropical dry forests have been lost.[3] There has been a doubling in global fish catch over the last 35 years. As a result half of all the fisheries are fully depleted and another 25% are overfished. According to UN reports about 1.2 billion people worldwide drink polluted water, causing hundreds of millions of cases of water related disease every

year and over 5 million deaths. By the year 2025, the demand for freshwater is expected to rise by 56% more than is currently available. If we are to survive for much longer on this planet we have no alternative but to turn to the promotion of values and ethics through education of different levels in order to make an impact on people's lifestyles and behaviour and help to build a sustainable future.

- The re-orientation of education is fundamental for sustainable development, not only for human survival but also for human well being and happiness — a better quality of life for everyone now and for generations to come. It will require an education that not only continues throughout life but also serve all people, draws upon all domains of knowledge and seeks to integrate learning into all of life's major activities. Basic education as defined by Delors Commission [4] aims at "learning to know, learning to do, learning to live together and learning to be". It provides the foundation for all future education and learning. In the context of sustainable development "Learning to know" aims to develop a deep understanding of the environment to develop faculties and reasoning, to develop coherent, critical thinking [5]. "Learning to do" will help the students to apply in practice what has been learned. "Learning to live together" aims at developing and understanding of other people and an appreciation of interdependence. "Learning to be" aims to develop one's personality and to be able to act with greater autonomy, judgement and learning responsibility. The over all goal is to produce children who are happy with themselves and with others, who find learning exciting and develop enquiring minds and an attitude seeking knowledge that they can develop and use throughout their lives. The goals of educating young children are focussed on ensuring their health development, happiness, well-being and adjustment to the environment in which they live. If these goals are not achieved the prospects of sustainable development diminishes.

- Traditional education on its own will not enable us to promote sustainable development. New educational approaches are needed to encourage necessary lifestyle. Changes to develop a new ecological vision and to nurture a sense of global solidarity and this is where, we, the science teachers can form a vital link in the teaching - learning - living process [6].

- Our role will be not only to introduce limited programmes and innovative demonstration projects but enlargement of our moral sensitivities which needs to be integrated in our formal teaching-learning process. Environmental education should focus on relevant issues found in the locality, relating them in turn to the global context and showing the inter connectedness of the natural world and of human activity. A distinction should be made between the science of ecology and much broader spectrum of environmental issues and concerns which enter all aspects of daily life and should be integrated across the curriculum.

- The International Bureau of Education (IBE) incorporated two key phrases in the theme course in the sub-regional workshop in New Delhi (1999) which was "the adaptation of content to the demands of the globalization and the need for learning to live together. Keeping this in minds it was suggested that the concepts of 'use of' and 'respect for' the environment should be taught as complementary to each other and should be integrated in the whole curriculum, becoming part of the "School ideology". Environmental education is integral to the issues of globalization and of learning to live together" [7].

• The science teacher's role will be to evaluate the student's grasp of the concepts and the application of this learning on his daily behaviour, which also needs to be monitored. It was also suggested by IBE that aspects of environmental law should be included which would assist in developing environmental awareness and changing behaviour.

• If teachers are to be able to provide this kind of quality education then there is an urgent need to bring in reforms in teacher education. The pre-service and initial-teacher education needs the follow up by recurrent in-service tacher orientation along with continuing professional self learning through books, journals, audio visual aids etc. To provide adequately equipped resource centres for teacher's education professional orientation for school principals and department heads are imperative. The policy makers need to have a thorough understanding of the pedogogical principles of organised teaching and learning.

• There is a need for revision and improvement of the educational content provided to the learners to make their learning relevant to their lives and community. Specific skills of learnings in sustaining bio-diversity is required to be imparted to the learners as learning by doing rather than cramming.

Along with professional competency there has to be a sense of value based commitment coupled with a distinct vision to achieve the desired changes in the student behaviour. To motivate the students the teachers themselves must have faith in the need ideology only then they can create the opportunity to learn which can help to build a sustainable future.

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THE TEACHERS CAN MAKE SURE THAT NO CHILD IS WITHOUT EDUCATION

— UNICEF

Conservation of Natural Resources for Sustainable Development

- Dr. Naveen Kumar,
Bihar State Pollution Control Board,
Patna.

The interrelationship between abiotic and biotic factors constitute the Environment. The environment of human beings includes the abiotic factors like land, water, atmosphere, climate, sound, etc and biotic factors like flora, fauna, bacteria and viruses. Our environment provides us all kinds of resources necessary for sustaining life including water, land, air, minerals, plants, animals, energy, etc.

Our Earth is the only planet that supports life and Man is the most evolved creative of nature. Since his appearance on the earth he has been exploiting the various natural resources available in his surroundings. The total world population has crossed six billion today and expected to grown by 3.7 billion by 2025. To meet the demands of this fast population build up a transition from agriculture to industrial society has been experienced with a thrust to provide more goods and services per person. The unsustainable use of our precious natural resources lead to pressure on nature's vital components resulting in depletion and degradation of natural on one hand and pollution and contamination on the other. It is estimated that about 2.0 billion people are affected by inadequate sanitation, 1.0 billion by unsafe water, 1.3 billion by air pollution, at present.

Man's quest for a better use of the available water is as old as mankind itself. Data available on global water resources suggests that the fresh water, essential to all lives is only a small portion, about 3.0% of the earth's water supply, of which the major portion i.e. about 70% of it is locked in ice caps and glaciers. The remaining small portion of fresh water has accumulated over centuries in the lakes and as underground water.

Rapid urbanization and industrialization has increased the demand of water in domestic and industrial sectors. Estimates show that the demand of water by the industrial sector will rise to 120 billion cubic meters, which will be about 11 to 12 per cent of the country's total water requirement in next twenty years, against the present day demand of about 35 cubic meters. So, we have to be very careful in drawing our management plans for best utilisation of our water resources to satisfy our demands for irrigation, power production, industries and other requirements.

In the present day world of consumerism, electricity has become our lifeline. But do we realize that 800 to 900gm. of coal is required for the production of one unit of power, which generates about 450 gm. of ash and other pollutants. So, on one hand we are depleting our natural resources and on the other piling up huge quantity of waste on land. In India about

60% of total requirement of power is met by Thermal Power Plants. There are 81 Thermal Power Plants in the country, which generates about 60,000 Mega watt of energy. It is estimated that in days to come the total demand of our country will be about 919 billion units which will require 450 million ton of Coal and 94 million ton of oil. Likewise, for the production of one ton of Steel, 33 ton of raw material, 10 ton of water, 15 ton of Air, 1 Kg of oil and 420 units of power is required which also generates 6 ton of effluent, 18 ton of polluted emission and one ton of solid waste. Industrial activities like these are causing depletion of our precious natural resources and causing detrimental effects on our environment.

One of the most important characteristics of the living world is diversity. Our Earth supports about 5 to 10 million species of plants and animals, which have been the result of three billion years of evolution involving mutation, variation, recombination and natural selection. India is considered as one of the Mega diverse country having a rich bio-diversity. About 7% of global wild plants and 6.5% of global animal species are found in our country. But due to the ever-increasing demands of mankind there is a wave of extinction of these species causing irreparable loss of our bio-diversity. We are leading towards on ecological crisis, which has threatened the whole life support system and the large number of habitats and species. The most important contribution of Earth's biota is to maintain the ability of ecological systems to provide essential life support series. Any imbalance created in this biological system affects the ability of the system to perform this function effectively. Thus, maintenace of bio-diversity is very important to human welfare.

Environmental degradation due to mismanagement have been noticed largely as we face water scarcity, water pollution, air pollution, loss of forest and bio-diversity, oil degradation, global warming and climate changes. The management of our natural resources should be as such that it should benefit all life on earth, including mankind so that it may yield sustainable benefit to the present generation without compromising with the needs of and aspirations of the future generation.

SCIENCE RELATED VALUES - *Pushpa jha*

Curiosity, quest for knowledge, objectivity, honesty and truthfulness, courage to question, systematic reasoning, acceptance after proof/verification, open-mindedness, search for perfection and team spirit are some of the basic values related to science. The processes of science, which help in searching the truth about nature and its phenomena are characterised by these values. Science aims at explaining things and events. Therefore to learn and practise science :

* **Be inquisitive about things and events around you.**
* **Have the courage to question beliefs and practise.**
* **Ask 'what', 'how' and 'why' and find your answers by critically observing, experimenting, consulting, discussing and reasoning.**
* **Record honestly your observations and experimental results in your laboratory or outside it.**
* **Repeat experiments carefully and systematically if required, but do not manipulate your results under any circumstances.**
* **Be guided by facts, reasons and logic. Do not be blased in one way or the other.**
* **Aspire to make new discoveries and inventions by sustained and dedicated work.**

"CREATIVE SCIENCE LEARNING MAKES A SCIENTIST"

- Dr. Ashok Kumar

Govt. Boys (+2) High School, L.B.S. Nagar, Patna-23

At the beginning of the twenty first century civilization is at a crisis. If one looks around the world one will be reminded of the poem by W.B. Yeats "Things fall apart the centre cannot hold, mere anarchy is loosed upon the world". There is an unprecedented destruction of earth's environment : deforestation, soil erosion, climatic changes, ozone depletion, Tsunami calamity, desertification, species extinction etc. There is tremendous political and social strife all over the world — regionalism, ethnicism, religious fundamentalism, terrorism, kidnapping etc. If our children have to tackle this difficult world, that they will be confronting when they grow up, the teacher today has to be committed to a new approach, so that they can prepare their children to face this difficult world.

There is an accusing finger pointed at the education system in India that it is outmoded. It is said that the the present system of rote and examination oriented learning are bringing in a devastating distortion in the personality of a child. In India children do not enjoy childhood. Those who can afford to go to school from very early childhood are overloaded with books and re-forced to rote learning. They have little time to play, explore, observe and enjoy. If the objective of education is to develop in the child the sense of wonder and curiosity, power of observation, problem-posing and problem-solving skills and development of conceptual understanding then the present method of education in Indian schools develops very little of these skills or perhaps, develops none. Children are fed with facts and more facts as they grow up but do not develop the skills to analyse, discern the essence of the problem and increase the cognitive and conceptual level. Though these aspects of learning process are true for any subject taught in a school but it is perhaps more true in the case of science education. It is said that 'Science is doing'. But 'doing Science' has been banished from most schools in India. It is surprising to note that even in the middle ages experimentation was given a very important place in the learning process. In a thirteenth-fourteenth century chemical treatise called 'Resendra Chintamani', the writer Ramchandra writes 'Those are to be regarded as real teachers who can verify by experiments what they teach-those are to be regarded as laudable disciples who can perform what they have learned-teachers and pupils, other than those are mere actors on the stage'. There is an ancient Chinese proverb of wisdom that says 'I read I forget, I see I remember, I do I understand'. This is perhaps the crystallized essence of learning process. The teacher must have to be first fired with the enthusiasm to create and eager want among the children to know and a good teacher is a conscious teacher with robust enthusiasm.

In the education system today emphasis is more on teaching than on learning. Though tremendous researches have been made as to the process of cognition development of a child very little is applied in our education system. It is necessary to dovetail our educational pack

age more on the basis of how a child learns than on how a teacher wants to teach. There are definite stages in the cognitive development of a child which are genetically determined. The ideal condition will be when each child in a class room is given the experience of doing an experimental or activity and thereby discover the process of nature and science himself. But this is not substitute of children doing the activity themselves. There is no comparison to joy and exhilaration when a child explores something himself.

Objectives of science learning

(a) To develop inquisitiveness and power of observation.

(b) To record, organize and classify data and information in tables, Histograms, Bar-diagram and graphs.

(c) To discover patterns, orders and sets in such observation and processes.

(d) To generate further information by experiments and activity.

(e) To analyse the available data so as to reach logically consistent and empiri cally valid conclusions called hypothesis.

(f) To abstract such conclusions in order to conceive 'theories' and 'models' so as to be able to 'predict' phenomenon.

To achieve the above objectives children have to do things by themselves. The basis of doing things is experimentation and activity. The following are important in Indian situation:

(a) Environment around us should be used as far as possible to learn science.

(b) Material used should be simple, cheap and should be locally available.

(c) Classroom can be utilize for science learning if separate laboratory is not available.

(d) Common school system is the only alternative.

(e) The whole syllabus of science & environment science to be taught has to be learnt through experiments and activity as far as possible.

Conclusion:

Science and technology plays a very important role in man's life today. There is a great alienation between common man and science. Science has become more like a magic box which common man cannot comprehend or understand. Yet, science developed in society through the ages to unravel the mysteries of nature and nature's process. The sense of wonder and quest is the source of all arts, sciences. A teacher's role is to create this sense of wonder and a thirst for eager want in a child. There should be a constant endeavour in a teacher to fire the imagination of a child.

"Curiosity is the major driving force of all science. People think that to be a good scientist you've to be highly intelligent. Well, You certainly have to be a bit intelligent but what you really need is to be interested and highly curious. Unless you really want to know the answer, you will never be able to contribute to new scientific discoveries".

Report of programmes of scientific awareness (2nd phase)

YEAR OF SCIENTIFIC AWARNESS- 2004

Organised by : All India Science Teacher's Association

Catalysed and supported by :

Rashtriya Vigyan Evam Prodyogiki Sanchar Parisad, D.S.T, New Delhi.

In continuation with previous reports—

1. ANANDA ASHRAM BALIKA VIDYAPITH, KOLKATA-700 047,

4th December, 2004:

The main items of the programme were talks on scientific awareness, exhibition, computer fair, appliances with the use of solar energy, quiz contest through demonstrations, symposium on disaster management by students, formulation of YSA programme through mock panchyaet, dance and drama on scientific awareness etc. Dr. Asish Kumar Ghosh, Working President, S.O.C. YSA-2004, gave an illuminating talk on different aspects of YSA. Sri Abhijit Bardhan, Dr. S.N. Giri, Sri Santosh Mitra, Dr. K.K. De and other distinguished personalities were also took part in the programme. Sm. S. Bhattacharya was the co-ordinator.

2. VIDYASAGAR TEACHERS' TRAINING COLLEGE, MIDNAPORE(WEST),

18th December, 2004:

The YSA programme was presided over by Dr. Jyotirmoy Nandy, In-charge of the college. Three distinguished persons, Prof. Manoranjan Maity (Ex Dean, Vidyasagar University), Prof. Nishikanta Maity of Raja N. L. Khan Mahila Mahavidyalaya, Dr. Ashis Kumar Gupta of Vidyasagar Teacher's Training College discussed different issues of YSA and explained significance of observing YSA-2004 throughout the country. A quiz and a debate contest on scientific awareness were also organised. Dr. Atul Krishna Mondal, Ex-Reader, Vidyasagar Teachers' Trg. College was the co-ordinator.

3. SUKANTANAGAR VIDYANIKETAN, KOLKATA, SALT LAKE,

22nd December, 2004:

The YSA programme was participated by teachers, students and guardians and members of our Association. Dr. S.N. Giri, President of AISTA, in his inaugural address discussed the importance of observing YSA-2004. In this connection, he gave strees on the main issues delineated by DST, New Delhi, Govt. of India. Dr. Pratip Kumar Pal, Headmaster, B.T. Road Govt. Sp. H.S. School, Kolkata, emphasised on spreading scientific awareness among the students, teachers and the public. A quiz contest was organised on the occasion. Sri Sibendu De, Headmaster of the organising school and the co-ordinator of YSA programme gave vote of thanks to the chair and to all who attended the programme.

4. DIHIBAGNAN K.B. ROY H.S. SCHOOL, HOOGHLY,

22nd December, 2004:

The venue of the programme was situated in a rural region of West Bengal. Prof. D. Majumdar, an educationist as well as a scientist, organised YSA programme in a befitting manner with the participation of a large number of students, teachers and public. A quiz contest was

arranged. Recitation, drama and other events on scientific awareness were performed as a part of the cultural programme organised on this occasison.

5. NAWABGANJ HIGH SCHOOL, 24-PARGANAS (NORTH),

15th January, 2004:

Dr. M. M. Chel, Secretary, AISTA, Dr. A. Hazra, Prof. A.P.C. College, New Barrackpur, Sri Madhusudan Ghosh, Chairman, New Barrackpur Municipality, Sri M. M. Nath, eminent educationist, Dr. Subir Kumar Sarkar, Headmaster, Nawabganj High School, and co-ordinator, of the programme, Dr. Gautam Nayak, physicians and many teachers of different schools and 175 students of 12 High and H.S. schools took part in the programme. The programme started at 12 noon and ended at 5-30 p.m. The school auditorium and different class rooms were displayed with posters containing different themes of scientific awareness. The distinguished guests delivered lectures on importance of scientific awareness among all. Students took part in quiz contest, talk, debate, recitation, song, drama and exhibition related to scientific awareness.

6. D.K. GIRLS HIGH SCHOOL, DEBAGRAM, NADIA,

15th January, 2005:

The co-ordinator of the programme was Smt. Mukti Mitra, Headmistress of the school and Dr. Ashis Biswas was the Jt. Co-ordinator. Distinguished educationists and science teachers gave deliberation on scientific awareness which encouraged the participants. Many students took part in different programmes of scientific awareness.

7. B.T. ROAD GOVT. SP. H.S. SCHOOL, KOLKATA-2,

22nd January, 2005:

Dr. Pratip Kumar Pal, Headmaster of the school was the co-ordinator. The programme was attended by a large number of teachers, students and guardians of different schools. In the inaugural session, Dr. Anandadev Mukherjee, Ex-Vice-chancellor, Vidyasagar University was the chief guest. In his address, he highlighted different aspects of scientific awareness and discussed the role of teachers in the process of dissemination of scientific awareness in the respective regions. Prof. K.K. De, Sri Santosh Mitra and many other distinguished educationists also deliberated on the occasion. Quiz contest, symposium, drama and other programmes lasted for more than six hours and the Programme was a grand success.

8. FAKIR CHAND COLLEGE, DIAMOND HARBOUR, 24-PARGANAS,

30th January, 2005:

YSA-2004 programme was organised by Prof. Tarasankar Das of the college. Dr. M.M. Chel, Secretary, AISTA, gave the key-note address and elaborated different issues of scientific awareness. He explained why dissemination of different aspects of scientific awareness among the public is extremely necessary. Other speakers also participated on the occasion. Recitation, song and drama on scientific awareness were also held. The meeting was ended with [illegible] of thanks to all who attended the programme.

9. ANNUAL CONFERENCE OF AISTA AT PATNA,

26- 28 December, 2004:

The focal theme of the Annual Conference of AISTA at Patna was 'Scientific and Technological Awareness (STA) for all. In the inaugural session the focal issue was discussed by distinguished personalities of science, Vice-chancellor of universities and other luminaries in the field of science education. A wide range of media, television and news papers both as state level and national level covered the programme. A session on developing strategies of dissemination of scientific awareness was also organised. Several papers was also presented in this session. The detailed report is published in our official journal, Vigyan Shikshak of AISTA. Photographs are also published in the journal Vigyan Shikshak of Jan-March 2005 issue.

10. SCIENCE DAY OBSERVED AT S.K. SCIENCE CENTRE, GANDHI MAIDAN, PATNA

Patna, 28.2.2005.

In the perspective of "International Year of Physics", Science Day is observed on 28th Feb. 2005 at Patna. On the occasion science rally, science drama and popular lecture was organised at S.K. Science Centre, Patna. The topic of the popular science lecture was "Tsunami, a geological time bomb." The main speaker was Prof. A.Rohatgi of Deptt. of Geology, Patna University. The lecture session presided over by Prof. S.N. Ahsan, Ex-V.C. of Patna University. Prof. J. Thakur, V.C. of P.U. was the chief guest while Prof. K.V. Srinivasan & Prof. Amitabh Ghosh were special guests.

On this occasion the special conference issue of AISTA'S Vigyan Shikshak magazine was released by Prof. J. Thakur, V.C. of P.U. Distinguished personalities like Prof. S.K. Ganguli, Prof. Daisy Narain, Sri R.N. Jha, Sri P.N. Mahaton, Sri R.L.P. Chaurasia, Sri Mahabir Singh, Sri Rabindra Prasad Sinha, Sri Mukhtar Singh, Dr. Ashok Kumar, Dr. Pushpa Jha, Prof. S.C. Shrivastava, Sri Awadhesh Kumar Shrivastava, Sri Shailendra Kumar Sharma, Sri Sumantji and others were also present. The session was conducted by Sri D.S. Shekhawat and the vote of thanks was offered by Sri Satish Ranjan Singh of S.K. Science Centre, Patna. The programme was organised by All India Science Teachers' Association and S.K. Science Centre, Patna.

11. AISTA'S PATNA DIST. COMMITTEE FORMED.

The Patna district committee of AISTA is formed on 12th March 2005 at a meeting held at the premise of Bihar Secondary Teachers Association, Patna. Mr. Nagendra Kumar Singh is elected as co-ordinator. Mr Ayodhya Prasad and Mr. Avanindra Kumar Sinha, Mr. Parmanand Vidyarthi and Mr. Shambhu Nath Tiwary, Mr. Sushil Kumar, Mr. Sidhnath Singh, Mr. Suraj Deo Singh, Mr. Dikshit and Mr. Sadhu Sharan were elected joint co-ordinators.

The meeting was presided over by Mr. R.N. Jha. A large number of teachers attended the meeting.

SCIENCE APTITUDE & TALENT SEARCH TEST (SATST)

All India Science Teacher's Association (AISTA) organises "Science Aptitude & Talent Search Test" every year through out the country in the month of February. Students from class IV to X appear in the SATST. The aim of the Test is to acquaint the students with the basic principles of science and mathematics, to develop an interest in learning scientific principles and to foster an investigatory attitude among the learners. It is also aimed that the Test would help the students in diagnosing their difficulties and/ or recognising their achievements.

The questions are according to the syllabus of CBSE/NCERT/ ICSE. Multiple choice type question in English is set on physical science, life-science, mathematics and general knowledge related to science. Any number of students can appear from a school.

A large number of prizes, medals, cash awards and certificates are distributed to successful candidates.

Any Institution can enroll about 100 students from his own school and/ or from neighbouring schools, a new centre may opened. The organiser may contact to **The Director, Science Aptitude & Talent Search Test, 62E, Vivekananda Sarani, Calcutta-700078. The Telephone no. is 033-24164648.**

Here we are providing a sample set of questions of class VII.

Due to lack of space only 60 questions are given out of 80 questions.

— Editor

All India Science Teacher's Association

SCIENCE APTITUDE AND TALENT SEARCH TEST -200-04

Class-VII | Full Marks -80 | Time - 2 Hrs.

INSTRUCTION : Write your name, Class, Roll No . etc. in the answer-sheet. Select the correct answer out of (a), (b), (c) and (d) of particular item and put a cross marks⊗ on the specific 'circle' denoting the correct answer. For example, if (c) is the correct answer to Question No. x: put cross like this: Q. No. x: oo ⊗ o. Rough, work is to be done on separate paper. Marks will be deducted for wrong answer . Don't waste time for answering a question which appears difficult to you, better try the next question.

1. **Goitre disease is caused due to**
   (a) deficiency of calcium (b) deficiency of iron
   (c) deficiency of iodine (d) excess of iodine
2. **Excessive intake of fat soluble vitamins in the form of pills can lead to**
   (a) hypervitaminosis (b) hypovitaminosis
   (c) typhoid (d) diarrhoea
3. **The test tube baby means a baby**
   (a) Grown in test tube (b) With fertilized and developed embryo in test tube

(c) with fertilization and development both in uterus

(d) with fertilization in vitro and then transplantation in uterus

4. High cholesterol patients are advised to use

(a) fatty oils and butter (b) cheese, dalda and ghee

(c) ghee, butter and oils (d) margarine and vegetable oils

5. Lichens are example of

(a) parasite (b) saprobhyte (c) symbiosis (d) insectivorus

6. If we uncover half of the forest covering of the earth, what crisis will be produced at most and at first ?

(a) Energy crisis will occur (b) Rest half forests will maintain in imbalance

(c) Some species will be extincted (d) Population and ecological imbalance will rise up

7. During photosynthesis plants intake

(a) CO (b) CO_2 (c) O_2 (d) SO_2

8. Nephridia is present in

(a) silk worm (b) earth worm (c) paramoecium (d) chlorobium

9. Which is Not digestive enzyme ?

(a) Amylase (b) Ligase (c) Lipase (d) Sucrase

10. Which one is excretory product in plants ?

(a) Calcium chloride (b) Sodium (c) Calcium oxalate (d) Sodium oxalate

11. Master gland secrets a hormone called

(a) thyroxine (b) thyrotropic hormone

(c) testosterone (d) estrogen

12. Which of the following pair of disease is caused by virus ?

(a) typhoid, tetanus (b) AIDS, syphilis

(c) rabies, mumps (d) cholera, tuberculosis

13. Pasterurisation is a process, which means heating of drinks. It is carried out, at what temperature and for how much duration ?

(a) 120°C and 60 minutes (b) 60°-70°C and 30 minutes

(c) 70°C and 60 minutes (d) 80°C and 30 minutes

14. Transport of O_2 and CO_2 by blood happens with the help of

(a) RBCs and blood plasma (b) RBCs and WBCs

(c) WBCs and blood serum (d) platelets and corpuscles.

15. The core metal of chlorophyll is

(a) Fe (b) Mg (c) Ni (d) Cu

16. Haemoglobin is

(a) an enzyme (b) a globular protein (c) a vitamin (d) a carbohydrate

17. In coming years, skin-related disorders will be more common due to

(a) air pollution (b) use of detergents

(c) water pollution (d) depletion of ozone layer

18. Which gland is both exocrine and endocrine ?

(a) Pancreas (b) Thyroid (c) Pituitary (d) Adrenal

19. The solid part of the earth's crust is called

(a) hydrosphere (b) atmosphere (c) lithosphere (d) none of a to c

20. Which item in the column B matches the item given in column A ?

Column A	Column B
Sperm	(a) Female organ
	(b) Growth
	(c) Male gamete
	(d) Pituitary

21. The muscle are attached to bones by

(a) dendrons (b) tendons (c) plasma (d) lymph

22. The process of asexual reproduction in Amoeba is called

(a) binary fission (b) binary fixation (c) fertilization (d) fermentation

23. Paramoccium is made up of only

(a) two cells (b) three cells (c) one cell (d) none of a to c

24. Vaccination is used to

(a) prevent spread of disease (b) stimulate spread of disease

(c) accelerate blood circulation (d) prevent blood circulation

25. Vitamin C is known as

(a) malic acid (b) ascorbic acid (c) fumaric acid (d) acetic acid

26. Which of the following has the minimum speed ?

(a) Light waves (b) Moon (round the earth)

(c) Earth (round the sun) (d) Radio wave

27. The value of 'g', where 'g' has the usual meaning, is

(a) 9.8 m/s^2 (b) 9.8 m/s (c) 9.8 m (d) 9.8

28. Which of the following statements is FALSE ?

(a) Mass of a body is a measure of its interia

(b) Thrust is the force acting perpendicular to a surface.

(c) Pressure=Thrust × Area

(d) The sp.heat of water is the highest of all the liquids and solids.

29. Mercury is not generally used today as a barometric substance, because it is

(a) transparent (b) heavy

(c) expensive (d) heavy, expensive and easily spilled.

30. A man never sinks in the Dead Sea, because

(a) the Dead Sea is too deep to sink

(b) there is no wave in the Dead Sea water

(c) the water of the Dead Sea is much more saline than that of other seas

(d) Archimedes' Principle is ineffective in the case of the Dead Sea water

31. When heat is supplied to a substance, its rise in temprature depends

(a) only on the amount of heat supplied to it (b) only on the mass of the substance

(c) only on the nature of the substance (d) on all the three above

32. The international unit of heat energy is

(a) Celcius (b) Joule (c) Calorie (d) Kilocalorie

33. The amount of heat required by a body of mass m and specific heat s to rise its temperature from t_1°C to t_2°C is

(a) ms $(t_1 - t_2)$ cal (b) ms $(t_2 - t_1)$ cal (c) ms $(t_1 - t_2)$ (d) ms $(t_2 - t_1)$

34. The focal length of a spherical mirrior is 15 cm. Its radius of curvature will be

(a) 15 cm (b) 7.5 cm (c) 30 cm (d) 22.5 cm

35. Tracing paper is

(a) translucent (b) transparent (c) opaque (d) neither of a to c.

36. In which medium does sound travel fastest ?

(a) Vacuum (b) air (c) water (d) steel

37. A body can be charged by

(a) rubbing it against another appropriate body (b) touching it to a charged body

(c) bringing a charged body near it (d) all of the above methods

38. If 1200 columbs of charge pass through a conductor in a period of 10 minutes, then the amount of current passing through it is

(a) 120 amp (b) 12000 amp (c) 2 amp (d) 72000 amp

39. Which of the following acts as a negative terminal in a torch-battery ?

(a) Carbon rod (b) Ammonium chloride (c) Manganese di-oxide (d) Zinc casing

40. Working of electric bells is based on

(a) heating effect of current (b) magnetic effect of current

(c) chemical effect of current

(d) the combination of heating and magnetic effects of current

41. Which of the following pairs is not a pair of immiscible liquids ?

(a) milk, water (b) petrol, water (c) water, alcohol (d) water, spirit

42. The atomicity of sulpher is

(a) 2 (b) 4 (c) 6 (d) 8

43. The formula of 'phitkari' is

(a) K_2SO_4, $14H_2O$ (b) $Al_2(SO_4)_3$, $14H_2O$

(c) K_2SO_4, $Al_2(SO_4)_3$, $14H_2O$ (d) K_2SO_4, $Al_2(SO_4)_3$, $24H_2O$

44. Water is used as a coolant in engine because

(a) it is cold at normal temperature (b) it has high specific heat

(c) it is most easily available (d) it is cheap

45. Which of the following reacts most vigorously with water ?

(a) Sodium (b) Magnesium (c) Calcium (d) Iron.

46. **Which of the following is dry-ice ?**

(a) Dry frozen water (b) Frozen carbondioxide (c) Frozen helium (d) Frozen air

47. **Which of the following is not a mixture ?**

(a) Duralumin (b) Bronze (c) Blue vitriol (d) Air

48. **Which of the following changes is a physical change ?**

(a) Milk into curd (b) Heating of sugar in a test tube to turn black

(c) Heating of wire by passing electric current (d) Burning of magnesium ribbon

49. **A voltameter is used for**

(a) the measurement of potential difference (b) the measurement of current

(c) the measurement of power (d) electrolysis

50. **The percentage of iron in Fe_2O_3 is**

(a) 112 (b) 56 (c) 70 (d) 30

51. **Vallency of sulpher is**

(a) 2 (b) 4 (c) 6 (d) 2,4,6.

52. **Which of the following is NOT a general property of acids ?**

(a) Acids have a sour taste (b) Acids react with carbonates to liberate carbon

(c) Acids contain hydrogen (d) Acids turn blue litmus red

53. **Which of the following has the highest water content ?**

(a) Cucumber (b) Egg (c) Potato (d) Human body

54. **Which of the following is insoluble in water ?**

(a) $AL(OH)_3$ (b) $Ca(OH)_2$ (c) NaOH (d) KOH

55. **Which of the following reactions is FALSE ?**

(a) $Ca + 2H_2O \rightarrow Ca\ (OH)_2 + H_2\uparrow$ (b) $2Fe\ (OH)_3 \rightarrow Fe_2O_3 + H_2O$

(c) $4P + 5O_2 \rightarrow 2P_2O_5 + \text{Heat}$ (d) $4P + 5O_2 \rightarrow 2P_2O_5 - \text{Heat}$

56. **If $2^7 \div 4^6 \times 2^5 = 3^p$, the value of p is**

(a) 3 (b) 5 (c) 1 (d) 0

57. **Find the largest number that will divide 432, 534 and 398 leaving the remainder 7 in each case.**

(a) 17 (b) 19 (c) 13 (d) 8

58. **If 2, 3, 5 be digit at $\frac{1}{10}$ th, $\frac{1}{1000}$ th and 10 th place respectively, the number is**

(a) 235 (b) 50203 (c) 2035 (d) 3205

59. **Which of the following numbers is greatest ?**

(a) $\frac{31}{29}$ (b) $\frac{43}{41}$ (c) $\frac{23}{21}$ (d) $\frac{19}{17}$

60. **$ax + b = c$ to be solvable for x, it is necessary that**

(a) $a \neq 0$ (b) $b \neq 0$ (c) $c \neq 0$ (d) $x \neq 0$

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बिहार माध्यमिक शिक्षा कार्यालय, बुद्धमार्ग, पटना

प्रेषक,

निदेशक (माध्यमिक शिक्षा)

बिहार, पटना ।

सेवा में,

सभी क्षेत्रीय उप शिक्षा निदेशक

सभी जिला शिक्षा पदाधिकारी

पटना, दिनांक 21 दिसम्बर, 04

विषयः— आल इंडिया सांयस टीचर्स एसोसिएशन (AISTA) के 39 वां अखिल भारतीय वार्षिक सम्मेलन के आयोजन में सहयोग के संबंध में ।

महाशय,

उपर्युक्त विषय के प्रसंग में निदेशानुसार कहना है कि आल इंडिया साईन्स टीचर्स एसोसिएशन का 39 वां अखिल भारतीय वार्षिक सम्मेलन आगामी 26, 27 एवं 28 दिसम्बर, 04 को पटना विश्वविद्यालय के विमेन्स ट्रेनिंग कॉलेज, उत्तरी गांधी मैदान में आयोजित होने जा रहा है । इस सम्मेलन में देश के विभिन्न भागों से शिक्षक एवं वैज्ञानिक भाग लेने पटना आ रहे हैं । कृपया राज्य के राजकीय/राजकीयकृत उच्च विद्यालय के विज्ञान शिक्षक सम्मेलन में भाग लें, यह सुनिश्चित कराया जाए। यथा संभव स्वंय भी भाग ले सकते हैं । इस सम्मेलन में भाग लेने के क्रम में वित्तीय भार यथा रजिष्ट्रेशन शुल्क, यात्रा भत्ता आदि शिक्षकों को ही उठाना पड़ेगा । जो शिक्षक इस सम्मेलन में भाग लेगें उन्हें कर्त्तव्य पर माना जायेगा । इस आशय की सूचना सम्बन्धित प्रधानाध्यापक को अपने स्तर से दें एवं शिक्षकों को इस सम्मेलन में भाग लेने हेतु प्रोत्साहित करें ।

विश्वासभाजन,

निदेशक (माध्यमिक शिक्षा)

बिहार, पटना

...uvenir released by Prof. Raziya Tabassum, on her left.,Mr. R. P. Sinha, Dr. S. N. Giri, Dr. M. M. Chel, Dr. Ashok Kumar, Mr. Mukhtar Singh ... Raziya Hussain and right Dr. S. N. Hota, Dr. Asit Das and Dr. Amitabh Ghosh.

In the valedictory session : Prof. K. K. Dey, Prof. Raziya Tabassum, Dr. S. N. Giri and Dr. M. M. Chel

Hon'ble M. L. C. and popular mass leader Md. Yunus Lohiya addressing the valedictory session.

A view of the Academic Session : Prof. J. C. George is presiding over the session, on her left Mrs. Raziya Hussain and right Dr. M. M. Chel

Dr. Naveen Kumar, Senior Scientist Bihar Pollution Control Board addressing academic session

A View of the valedictory function.

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